

11/21/2002

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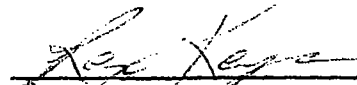
ERRS Region 8 Memorandum

TO: U.S. Army Corps of Engineers and U.S. Environmental Protection Agency
FROM: Dan Stern
DATE: November 21, 2002
SUBJECT: Cap Approval
Cc: Russ Gulledge

Cap Approval

Environmental Restoration L.L.C. completed the select fill and topsoil cap over the liner cell containing solidified/stabilized mine tailings at the Mineral County Airport. A 12 inch select fill cap was placed over the liner as per the design plan developed by the U.S. Army Corps of Engineers. The 12 inch select fill cap was installed under the guidance of the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers and meets the specifications of the plan. The 12 inch topsoil was installed according to the specifications of the design plan and under the guidance of the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. The cap meets the design plan specifications and is therefore determined to be acceptable by the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers.


Environmental Restoration L.L.C.

 Rex Keys

U.S. Corps of Engineers

 Mark E. Buss

U.S. E.P.A.

 JOHN MCKENNA



Y902

ENVIRONMENTAL RESTORATION, LLC

ERRS Region 8 Memorandum

TO: Barber Webb, U.S. C.O.E., and U.S. E.P.A.
FROM: Dan Stern
DATE: November 19, 2002
SUBJECT: Liner Acceptability Statement
Cc: Russ Gullledge

Liner Materials

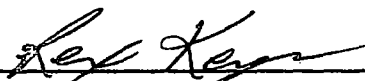
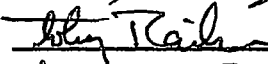


Barber Webb completed installation of the liner covering the permanent solidified/stabilized mine tailings containment cell. The liner was completed according to the design developed by the U.S. Army Corps of Engineers. The installation of the liner was conducted under the guidance of the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. Environmental Restoration, L.L.C. has determined that the liner was installed according to the specifications of the contract and is therefore acceptable.

Environmental Restoration L.L.C.

Barber Webb

U.S. Corps of Engineers

U.S. E.P.A.

TO: Barber Webb, U.S. C.O.E., and U.S. E.P.A.
FROM: Dan Stern
DATE: November 18, 2002
SUBJECT: Cell Surface Inspection
Cc: Russ Gulledge

Cell Surface Inspection

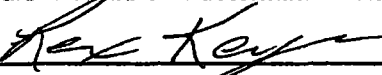
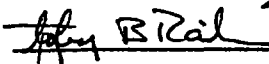
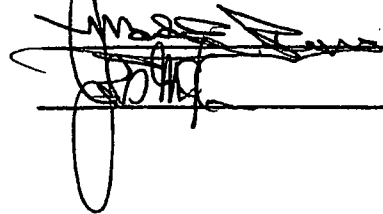
Environmental Restoration L.L.C. prepared a permanent storage cell for containment of stabilized/solidified mine tailings. The cell was prepared according to a design plan developed by the U.S. Army Corps of Engineers. The cell preparation was constructed under the guidance of the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. The 6 inch compacted select-fill liner substrate was inspected by Barber Webb and determined suitable for liner installation.

Environmental Restoration L.L.C.

Barber Webb

U.S. Corps of Engineers

U.S. E.P.A.

1800 75 3755 1001
SECTION 02372

GEOMEMBRANE

10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referenced in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 638	(1999) Tensile Properties of Plastics
ASTM D 1004	(1994a) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1505	(1998) Density of Plastics by the Density-Gradient Technique
ASTM D 1603	(1994) Carbon Black in Olefin Plastics
ASTM D 3895	(1998) Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
ASTM D 4218	(1996) Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique
ASTM D 4833	(2000) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 5199	(1999) Measuring Nominal Thickness of Geotextiles and Geomembranes
ASTM D 5596	(1994) Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
ASTM D 5721	(1995) Air-Oven Aging of Polyolefin Geomembranes
ASTM D 5885	(1997) Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
ASTM D 6392	(1999) Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

GEOSYNTHETIC INSTITUTE (GSI)

GSI GRI GM-9 (1995) Cold Weather Seaming of Geomembranes

GSI GRI GM-11 (1997) Accelerated Weathering of Geomembrane
Using a Fluorescent UVA Device

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Layout and Detail Drawings ; G-RE

Geomembrane panel layout and penetration detail drawings, a minimum of ~~7~~ ^{ASAP} days prior to geomembrane placement.

As-Built Drawings ; G-RE

ER - Final as-built drawings of geomembrane installation

SD-03 Product Data

Tests, Inspections, and Verifications ; G-RE

Manufacturer's QC manuals, a minimum of 7 days prior to geomembrane shipment.

Field Seaming ; G-RE

Installer's QC manual, a minimum of 7 days prior to geomembrane placement.

Qualifications ; G-RE

Manufacturer's qualification statement, including ~~resumes~~ of key personnel involved in the project, a minimum of 7 days prior to geomembrane shipment. *ASAP*

Installer's and QC laboratory's qualification statements including resumes of key personnel involved in the project a minimum of 7 days prior to geomembrane placement. The submittal from the QC laboratory shall include verification that the laboratory is accredited via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP) for the tests the QC laboratory will be required to perform.

SD-06 Test Reports

Material ; G-ED

Manufacturer's certified raw and sheet material test reports and a copy of the QC certificates, a minimum of 7 days prior to shipment of geomembrane to the site.

Surface Preparation ; G-RE

Certification from the installer of the acceptability of the surface on which the geomembrane is to be placed, immediately prior to geomembrane placement.

Non-Destructive Field Seam Continuity Testing ; G-RE

Certified test results on all field seams.

Destructive Field Seam Testing ; G-RE

Installer and certified QC laboratory test results on all destructively tested field seams.

Destructive Seam Test Repairs ; G-RE

Certified test results on all repaired seams.

Tests ; G-RE

Certified QC test results.

1.5 QUALIFICATIONS

1.5.1 Manufacturer

Manufacturer shall have produced the proposed geomembrane sheets for at least 5 completed projects having a total minimum area of 10 million square feet.

1.5.2 Installer

The installer is responsible for field handling, deploying, seaming, anchoring, and field Quality Control (QC) testing of the geomembrane. The installer shall have installed the proposed geomembrane material for at least 5 completed projects having a total minimum area of 2 million square feet. At least one seamer shall have experience seaming a minimum of 500,000 square feet of the proposed geomembrane using the same type of seaming equipment and geomembrane thickness specified for this project.

1.5.5 QC Laboratory

The QC laboratory shall have provided QC and/or Quality Assurance (QA) testing of the proposed geomembrane and geomembrane seams for at least five completed projects having a total minimum area of 2 million square feet. The QC laboratory shall be accredited via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP) for the tests the QC laboratory will be required to perform.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Delivery

The Contracting Officer shall be present during delivery and unloading of the geomembrane. Each geomembrane roll/panel shall be labeled with the manufacturer's name, product identification number, roll/panel number, and roll dimensions.

1.6.2 Storage

Temporary storage at the project site shall be on a level surface, free of sharp objects where water cannot accumulate. The geomembrane shall be protected from puncture, abrasion, excessive heat or cold, material degradation, or other damaging circumstances. Storage shall not result in crushing the core of roll goods or flattening of the rolls. Rolls shall not be stored more than two high. Palletized materials shall be stored on level surfaces and shall not be stacked on top of one another. Damaged geomembrane shall be removed from the site and replaced with geomembrane that meets the specified requirements.

1.6.3 Handling

Rolls/panels shall not be dragged, lifted by one end, or dropped. A pipe or solid bar, of sufficient strength to support the full weight of a roll without significant bending, shall be used for all handling activities. The diameter of the pipe or solid bar shall be small enough to be easily inserted through the core of the roll. Chains shall be used to link the ends of the pipe or bar to the ends of a spreader bar. The spreader bar shall be wide enough to prevent the chains from rubbing against the ends of the roll. Alternatively, a stinger bar protruding from the end of a forklift or other equipment may be used. The stinger bar shall be at least three-fourths the length of the core and must be capable of supporting the full weight of the roll without significant bending. If recommended by the manufacturer, a sling handling method utilizing appropriate loading straps may be used.

1.7 WEATHER LIMITATIONS

Geomembrane shall not be deployed or field-seamed in the presence of excess moisture (i.e., rain, fog, dew), in areas of ponded water, or in the presence of excess wind. Unless authorized by the Contracting Officer, no placement or seaming shall be attempted at ambient temperatures below 32 degrees F or above 104 degrees F. Ambient temperature shall be measured at a height no greater than 6 inches above the ground or geomembrane surface. If seaming is allowed below 32 degrees F, the procedures outlined in GSI GRI GM-9 shall be followed. In marginal conditions, seaming shall cease unless destructive field seam tests, conducted by the QC laboratory, confirm that seam properties meet the requirements listed in Table 2. Tests shall be conducted in accordance with paragraph Destructive Field Seam Testing.

1.8 EQUIPMENT

Equipment used in performance of the work shall be in accordance with the geomembrane manufacturer's recommendations and shall be maintained in satisfactory working condition.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Raw Materials

Resin used in manufacturing geomembrane sheets shall be made of virgin uncontaminated ingredients. No more than 10 percent regrind, reworked, or trim material in the form of chips or edge strips shall be used to manufacture the geomembrane sheets. All regrind, reworked, or trim materials shall be from the same manufacturer and exactly the same formulation as the geomembrane sheet being produced. No post consumer materials or water-soluble ingredients shall be used to produce the geomembrane. For geomembranes with plasticizers, only primary plasticizers that are resistant to migration shall be used. The Contractor shall submit a copy of the test reports and QC certificates for materials used in the manufacturing of the geomembrane shipped to the site.

2.1.2 Sheet Materials

Geomembrane sheets shall be unreinforced and manufactured as wide as possible to minimize field seams. Geomembrane sheets shall be uniform in color, thickness, and surface texture. The sheets shall be free of and resistant to fungal or bacterial attack and free of cuts, abrasions, holes, blisters, contaminants and other imperfections. Geomembrane sheets shall conform to the requirements listed in Table 1 for Manufacturing Quality Control (MQC).

TABLE 1. SMOOTH LLDPE GEOMEMBRANE PROPERTIES

PROPERTY	TEST VALUE	MQC TESTING FREQUENCY (MIN.)	TEST METHOD
Thickness (min ave)	40 mils	per roll	ASTM D 5199
Lowest individual of 10 values	-10 percent	per roll	ASTM D 5199
Density (max)	0.939 g/cc	per 200,000 lb	ASTM D 1505
Tensile Properties (1) (min ave)		per 20,000 lb	ASTM D 638 Type IV
-break stress	152 lb/in		
-break elong	800 percent		
Tear Resistance (min ave)	22 lb	per 45,000 lb	ASTM D 1004
Puncture Resistance (min ave)	56 lb	per 45,000 lb	ASTM D 4833

Carbon Black Content	2.0-3.0 percent	per 20,000 lb	ASTM D 1603 Note (2)
Carbon Black Dispersion	Note (3)	per 45,000 lb	ASTM D 5596
Oxidative Induction Time (OIT) (min ave) (4)		per 200,000 lb	
-Std OIT	100 min		ASTM D 3895
or			
-High Pres OIT	400 min		ASTM D 5885
Oven Aging at 85 deg C (min ave) (4), (5)		per year and change in formulation	ASTM D 5721
-Std OIT	35 percent at 90 days		ASTM D 3895
or			
-High Pres OIT	60 percent at 90 days		ASTM D 5885
UV Resistance (min ave) (6)		per year and change in formulation	GSI GRI GM-11
-High Pres OIT (7) (8)	35 percent at 1600 hours		ASTM D 5885

MQC = Manufacturing Quality Control

Note (1): Minimum average machine direction and minimum average cross machine direction values shall be based on 5 test specimens in each direction. For LLDPE geomembrane, break elongation is calculated using a gage length of 2.0 inches at 2 inches/min.

Note (2): Other methods such as ASTM D 4218 or microwave methods are acceptable if an appropriate correlation to ASTM D 1603 can be established.

Note (3): Carbon black dispersion for 10 different views:
 - minimum 8 of 10 in Categories 1 or 2
 - all 10 in Categories 1,2, or 3

Note (4): The manufacturer has the option to select either one of the OIT methods to evaluate the antioxidant content.

Note (5): Evaluate samples at 30 and 60 days and compare with the 90 day response.

Note (6): The condition of the test shall be a 20 hour UV cycle at 167 degrees F followed by a 4 hour condensation cycle at 140 degrees F.

Note (7): The standard OIT test (ASTM D3895) shall not be used in determining UV resistance.

Note (8): UV resistance is based on percent retained value regardless of the original HP-OIT value.

TABLE 2. LLDPE SEAM PROPERTIES

PROPERTY	TEST VALUE	TEST METHOD
Seam Shear Strength (min) (1)	53 lb/in	ASTM D 6392
Seam Peel Strength (min) (1) (2)	44 lb/in	ASTM D 6392

Note (1): Seam tests for peel and shear must fail in the Film Tear Bond mode. This is a failure in the ductile mode of one of the bonded sheets by tearing or breaking prior to complete separation of the bonded area.

Note (2): Where applicable, both tracks of a double hot wedge seam shall be tested for peel adhesion.

2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

2.2.2 Manufacturing, Sampling, and Testing

2.2.2.1 Raw Materials

Raw materials shall be tested in accordance with the approved MQC manual. Any raw material which fails to meet the geomembrane manufacturer's specified physical properties shall not be used in manufacturing the sheet. Seaming rods and pellets shall be manufactured of materials which are essentially identical to that used in the geomembrane sheet. Seaming rods and pellets shall be tested for density, melt index and carbon black content in accordance with the approved MQC manual. Seaming rods and pellets which fail to meet the corresponding property values required for the sheet material, shall not be used for seaming.

2.2.2.2 Sheet Material

Geomembrane sheets shall be tested in accordance with the approved MQC manual. As a minimum, MQC testing shall be conducted at the frequencies shown in Table 1. Sheets not meeting the minimum requirements specified in Table 1 shall not be sent to the site.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Surface Preparation

Rocks larger than 1 inch in diameter and any other material which could damage the geomembrane shall be removed from the surface to be covered with the geomembrane. Construction equipment tire or track deformations beneath

the geomembrane shall not be greater than 1.0 inch in depth. Each day during placement of geomembrane, the Contracting Officer and installer shall inspect the surface on which geomembrane is to be placed and certify in writing that the surface is acceptable. Repairs to the subgrade shall be performed at no additional cost to the Government.

3.1.2 Anchor Trenches

Where an anchor trench is required, it shall be placed 36 inches back from the edge of the slope to be covered. The anchor trench shall be 24 inches deep and 24 inches wide. Ponded water shall be removed from the anchor trench while the trench is open. Trench corners shall be slightly rounded to avoid sharp bends in the geomembrane. Loose soil, rocks larger than 1 inch in diameter, and any other material which could damage the geomembrane shall be removed from the surfaces of the trench. The geomembrane shall extend down the front wall and across the bottom of the anchor trench.

3.2 GEOMEMBRANE DEPLOYMENT

The procedures and equipment used shall not elongate, wrinkle, scratch, or otherwise damage the geomembrane, other geosynthetic layers, or the underlying subgrade. Geomembrane damaged during installation shall be replaced or repaired, at the Contracting Officer's discretion. Only geomembrane panels that can be anchored and seamed together the same day shall be deployed. Adequate ballast (i.e., sand bags) shall be placed on the geomembrane, without damaging the geomembrane, to prevent uplift by wind. No equipment shall be operated on the top surface of the geomembrane without permission from the Contracting Officer. Seams shall be oriented parallel to the line of maximum slope. Where seams can only be oriented across the slope, the upper panel shall be lapped over the lower panel.

3.2.1 Wrinkles

The methods used to deploy and backfill over the geomembrane shall minimize wrinkles and tensile stresses in the geomembrane. The geomembrane shall have adequate slack to prevent the creation of tensile stress. The wrinkle height to width ratio for installed geomembrane shall not exceed 0.5. In addition, geomembrane wrinkles shall not exceed 6 inches in height. Wrinkles that do not meet the above criteria shall be cut out and repaired in accordance with the installer's approved QC manual.

3.3 FIELD SEAMING

3.3.1 Trial Seams

Trial seams shall be made under field conditions on strips of excess geomembrane. Trial seams shall be made each day prior to production seaming, whenever there is a change in seaming personnel or seaming equipment and at least once every four hours, by each seamer and each piece of seaming equipment used that day. Trial seam samples shall be collected and tested in accordance with ASTM D 6392. One sample shall be obtained from each trial seam. This sample shall be at least 36 inches long by 12 inches wide with the seam centered lengthwise. Ten random specimens 1 inch wide shall be cut from the sample. Five seam specimens shall be field tested for shear strength and 5 seam specimens shall be field tested for peel adhesion using an approved quantitative tensiometer. To be acceptable, 4 out of 5 replicate test specimens shall meet seam strength requirements.

specified in Table 2. If the field tests fail to meet these requirements, the entire operation shall be repeated. If the additional trial seam fails, the seaming apparatus or seamer shall not be used until the deficiencies are corrected by the installer and 2 consecutive successful trial seams are achieved.

3.3.2 Field Seams

Panels shall be seamed in accordance with the geomembrane manufacturer's recommendations. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Seaming shall extend to the outside edge of panels. Soft subgrades shall be compacted and approved prior to seaming. The seam area shall be free of moisture, dust, dirt, and foreign material at the time of seaming. Fish mouths in seams shall be repaired.

3.3.2.1 Polyethylene Seams

Polyethylene geomembranes shall be seamed by thermal fusion methods. Extrusion welding shall only be used for patching and seaming in locations where thermal fusion methods are not feasible. Seam overlaps that are to be attached using extrusion welds shall be ground prior to welding. Grinding marks shall be oriented perpendicular to the seam direction and no marks shall extend beyond the extrudate after placement. Extrusion welding shall begin within 10 minutes after grinding. Where extrusion welds are temporarily terminated long enough to cool, they shall be ground prior to applying new extrudate over the existing seam. The total depth of the grinding marks shall be no greater than 10 percent of the sheet thickness.

3.5 TESTS

The Contractor shall provide all QC samples to the QC laboratory to determine density, thickness, tensile strength at break, and elongation at break in accordance with the methods specified in Table 1. Samples not meeting the specified requirements shall result in the rejection of applicable rolls/panels. As a minimum, rolls/panels produced immediately prior to and immediately after the failed roll/panel shall be tested for the same failed parameter. Testing shall continue until a minimum of three successive rolls/panels on both sides of the original failing roll/panel pass the failed parameter.

3.5.1 Non-Destructive Field Seam Continuity Testing

Field seams shall be non-destructively tested for continuity over their full length in accordance with the installer's approved QC manual. Seam testing shall be performed as the seaming work progresses, not at the completion of field seaming. Any seams which fail shall be documented and repaired in accordance with the installer's approved QC manual.

3.5.2 Destructive Field Seam Testing

A minimum of one destructive test sample per 750 feet of field seam shall be obtained at locations specified by the Contracting Officer. Sample locations shall not be identified prior to seaming. Samples shall be a minimum of 12 inches wide by 42 inches long with the seam centered lengthwise. Each sample shall be cut into 3 equal pieces, with one piece retained by the installer, one piece given to the QC laboratory, and the remaining piece given to the Contracting Officer for QA testing and/or

permanent record. Each sample shall be numbered and cross referenced to a field log which identifies: (1) panel number; (2) seam number; (3) date and time cut; (4) ambient temperature within 6 inches above the geomembrane; (5) seaming unit designation; (6) name of seamer; and (7) seaming apparatus temperature and pressures (where applicable). Ten 1 inch wide replicate specimens shall be cut from the installer's sample. Five specimens shall be tested for shear strength and 5 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be in accordance with the approved QC manual. To be acceptable, 4 out of 5 replicate test specimens shall meet the seam strength requirements specified in Table 2. If the field tests pass, 5 specimens shall be tested at the QC laboratory for shear strength and 5 for peel adhesion in accordance with the QC laboratory's approved procedures. To be acceptable, 4 out of 5 replicate test specimens shall meet the seam strength requirements specified in Table 2. If the field or laboratory tests fail, the seam shall be repaired in accordance with paragraph Destructive Seam Test Repairs. Holes for destructive seam samples shall be repaired the same day they are cut.

3.6 DEFECTS AND REPAIRS

3.6.1 Destructive Seam Test Repairs

Seams that fail destructive seam testing may be overlaid with a strip of new material and seamed (cap stripped). Alternatively, the seaming path shall be retraced to an intermediate location a minimum of 10 feet on each side of the failed seam location. At each location a 12 by 18 inch minimum size seam sample shall be taken for 2 additional shear strength and 2 additional peel adhesion tests using an approved quantitative field tensiometer. If these tests pass, then the remaining seam sample portion shall be sent to the QC laboratory for 5 shear strength and 5 peel adhesion tests in accordance with the QC laboratory's approved procedures. To be acceptable, 4 out of 5 replicate test specimens must meet specified seam strength requirements. If these laboratory tests pass, then the seam shall be cap stripped or repaired using other approved methods between that location and the original failed location. If field or laboratory tests fail, the process shall be repeated. After repairs are completed, the repaired seam shall be non-destructively tested in accordance with paragraph Non-Destructive Field Seam Continuity Testing.

3.6.2 Patches

Tears, holes, blisters and other defects shall be repaired with patches. Patches shall have rounded corners, be made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects. Minor localized flaws shall be repaired by spot welding or seaming as determined by the Contracting Officer. Repairs shall be non-destructively tested. The Contracting Officer may also elect to perform destructive seam tests on suspect areas.

3.7 VISUAL INSPECTION AND EVALUATION

Immediately prior to covering, the geomembrane, seams, and non-seam areas shall be visually inspected by the Contracting Officer for defects, holes, or damage due to weather conditions or construction activities. At the Contracting Officer's discretion, the surface of the geomembrane shall be brushed, blown, or washed by the installer if the amount of dust, mud, or foreign material inhibits inspection or functioning of the overlying

material. Each suspect location shall be non-destructively tested in accordance with paragraph Non-Destructive Field Seam Continuity Testing. Each location that fails non-destructive testing shall be repaired in accordance with paragraph Patches and non-destructively retested.

3.9 PROTECTION AND BACKFILLING

The deployed and seamed geomembrane shall be covered with the specified material within 14 calendar days of acceptance. Wrinkles in the geomembrane shall be prevented from folding over during placement of cover materials. Cover soil shall not be dropped onto the geomembrane or overlying geosynthetics from a height greater than 3 feet. The soil shall be pushed out over the geomembrane or overlying geosynthetics in an upward tumbling motion. Soil shall be placed from the bottom of the slope upward. The initial loose soil lift thickness shall be 12 inches. Equipment with ground pressures less than 7 psi shall be used to place the first lift over the geomembrane. A minimum of 18 inches of soil shall be maintained between construction equipment with ground pressures greater than 7 psi and the geomembrane. Cover soil compaction and testing requirements are described in Section 02140. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

3.10 AS-BUILT DRAWINGS

Final as-built drawings of the geomembrane installation shall be prepared. These drawings shall include panel numbers, seam numbers, location of repairs, destructive seam samples, and penetrations.

-- End Of Section --

SECTION 02376

GEOSYNTHETIC CLAY LINER (GCL)

03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 4643	(1993) Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
ASTM D 5887	(1995) Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
ASTM D 5888	(1995) Storage and Handling of Geosynthetic Clay Liners
ASTM D 5889	(1995) Quality Control of Geosynthetic Clay Liners
ASTM D 5890	(1995) Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
ASTM D 5891	(1995) Fluid Loss of Clay Component of Geosynthetic Clay Liners
ASTM D 5993	(1996) Measuring Mass Per Unit of Geosynthetic Clay Liners
ASTM D 6243	(1998) Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liners by the Direct Shear Method
ASTM D 6496	(1999) Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Layout and Detail Drawings ; G-RE

GCL panel layout and penetration detail drawings a minimum of 14 days prior to deployment.

SD-03 Product Data

GCL Properties ; G-RE

Manufacturer's certified raw and roll material data sheets. If needle punching or stitch bonding is used in construction of GCL, the certification shall indicate that the GCL has been continuously inspected for broken needles using an in-line metal detector and all broken needles have been removed. The certified data sheets shall be attested to by a person having legal authority to bind the GCL manufacturing company. Certified test results shall be submitted at least 5 working days prior to delivery of the GCL.

Tests, Inspections, and Verifications ; G-RE

Manufacturer's quality control (QC) manual which describes testing procedures, frequency of testing and acceptance/rejection criteria for QC testing at least 14 days prior to delivery of the GCL.

Qualifications ; G-RE

Manufacturer's and installer's qualification statements including resumes of key personnel involved in this project.

SD-06 Test Reports

Subgrade Preparation ; G-RE

Certificate of subgrade inspection.

1.4 QUALIFICATIONS

1.4.1 Manufacturer

Geosynthetic clay liner shall be the product of a GCL Manufacturer who has produced the proposed GCL using the same bentonite, polyethylene geomembrane, geotextiles, sewing thread, and adhesive for at least 5 completed projects and shall have produced a minimum of 2,000,000 square feet of the proposed GCL.

1.4.2 Installer

The installer shall have installed GCL at a minimum of 5 projects of comparable scope and complexity and shall have installed a minimum of 2,000,000 square feet of the proposed GCL.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Delivery, storage, and handling of GCL shall be in accordance with ASTM D 5888. The Contracting Officer shall be present during delivery and unloading of the GCL. Rolls shall be packaged in an opaque, waterproof, protective covering and wrapped around a central core. Tears in the packaging shall be repaired to restore a waterproof protective barrier around the GCL. Unloading of rolls from the delivery vehicles shall be done preventing damage to the GCL and its packaging.

1.5.2 Storage

Field storage shall be in flat dry areas where water cannot accumulate and the GCL rolls can be protected from damage. Storage of the rolls on blocks or pallets will not be allowed unless the GCL rolls are fully supported as approved by the Contracting Officer. Stacks of GCL rolls shall be no greater than three high. Rolls shall be covered with a water proof tarpaulin or plastic sheet if stored outdoors.

1.5.3 Handling

Rolls shall not be dragged, lifted by one end, or dropped to the ground from the delivery vehicle. A pipe or solid bar of sufficient strength to support the full weight of the roll without significant bending shall be used for all unloading and handling activities. The diameter of the pipe shall be small enough to be easily inserted through the core of the GCL roll. Chains shall be used to link the ends of the core pipe to the ends of a spreader bar. The spreader bar shall be wide enough to prevent the chains from rubbing against the ends of the GCL roll. Alternatively, a stinger bar protruding from the end of a forklift or other equipment may be used. The stinger bar shall be at least three-fourths the length of the core and must be capable of supporting the full weight of the GCL without significant bending. If recommended by the manufacturer, a sling handling method utilizing appropriate loading straps may be used.

PART 2 PRODUCTS

2.1 GCL PROPERTIES

GCL shall be a manufactured product consisting of a sodium montmorillonite clay (bentonite) layer evenly distributed between two geotextiles. GCL shall conform to the property requirements listed in Table 1 and shall be free of tears, holes, or other defects which may affect its serviceability. Encapsulating geotextiles shall be mechanically bonded together using a needle punch or stitch bonding process. Needle punched and stitch bonded GCLs shall be continuously inspected for broken needles using an in-line metal detector and broken needles shall be removed. The minimum manufactured GCL sheet width shall be 13.5 feet and the minimum manufactured GCL sheet length shall be 98 feet.

TABLE 1 - GCL PROPERTIES

	TEST METHOD	TEST VALUE
BENTONITE		
Swell Index Test, minimum	ASTM D 5890	24 mL
Fluid Loss, maximum	ASTM D 5891	18 mL
COMPOSITE		
Bentonite Mass/Unit Area, MARV, Note 2	ASTM D 5993	0.75 lbs/sq foot
Peak Mid-Plane Shear Strength (hydrated), minimum Note 3	ASTM D 6243	500 psf
Index Flux, maximum	ASTM D 5887	0.00000001 cubic m/sq m/sec
Peel Strength, MARV MD	ASTM D 6496	15 lbs.

Note 1: MARV = minimum average roll value.

Note 2: Bentonite mass/unit area shall be computed at 0 percent moisture content. Moisture content shall be determined by ASTM D 2216 or ASTM D 4643. Bentonite mass/unit area is exclusive of glues added to the bentonite.

Note 3: Mid-plane shear strength testing is a MQC testing requirement.

2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

2.2.1 Manufacturing Sampling and Testing

GCL and its components shall be sampled and tested in accordance with the manufacturer's approved QC manual. The manufacturer's QC procedures shall be in accordance with ASTM D 5889. Test results not meeting the requirements specified in Table 1 shall result in the rejection of applicable rolls. The manufacturer's QC manual shall describe procedures used to determine rejection of applicable rolls. As a minimum, rolls produced immediately prior to and immediately after the failed roll shall be tested for the same failed parameter. Testing shall continue until a minimum of three successive rolls on both sides of the original failing roll pass the failed parameter.

PART 3 EXECUTION

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The subgrade shall be compacted in accordance with Section 02140. The subgrade surface shall be smooth and free of vegetation, standing water, and angular stones or other foreign matter that could damage the GCL. At a minimum, the subgrade surface shall be rolled with a smooth-drum compactor of sufficient weight to remove any wheel ruts, footprints, or other abrupt grade changes. All protrusions extending more than 0.5 inches from the subgrade (or less if recommended by the manufacturer) shall either be removed, crushed, or pushed into the surface with the smooth-drum compactor. The GCL shall not be installed on a frozen subgrade. Each day during placement of GCL, the Contracting Officer and installer shall inspect the surface on which GCL is to be placed and certify in writing that the surface is acceptable.

3.2.2 Placement

GCL shall be installed as soon as practical after completion and approval of the subgrade; but, GCL shall not be deployed if it is frozen. Rolls shall be delivered to the work area in their original packaging. Immediately prior to deployment, the packaging shall be carefully removed without damaging the GCL. GCL which has been hydrated prior to being covered by an overlying geomembrane shall be removed and replaced. Hydrated GCL is defined as material which has become soft as determined by squeezing the material with finger pressure or material which has exhibited swelling. If the subgrade is soil, construction equipment may be used to deploy GCL. Dragging of GCL panels over the ground surface shall be minimized. The Contracting Officer has the option of requiring the use of a slip sheet. Deployed GCL panels shall lie flat on the subgrade surface, with no wrinkles or folds.

3.2.3 Anchor Trench

Where anchor trenches are required, they shall be placed a minimum of 36 inches back from the edge of slopes to be covered. Anchor trenches shall be a minimum of 24 inches deep and 24 inches wide. The front edge of the trench shall be rounded to eliminate sharp corners that could damage the GCL. The GCL shall extend down the front wall and across the bottom of the anchor trench.

3.2.4 Seams

On side-slopes, GCL shall be placed with seams oriented parallel to the line of maximum slope and shall be free of tension or stress upon completion of the installation. Panels shall be positioned with the overlap recommended by the manufacturer, but not less than 6 inches after shrinkage for panel sides or 18 inches after shrinkage for panel ends. Dirt or other foreign matter shall be removed from the overlap area immediately prior to seaming. If recommended by the manufacturer, granular bentonite of the same type as the bentonite used for the GCL shall be placed along the entire overlap width at a minimum rate of 0.25 lbs/linear foot or as recommended by the manufacturer. Construction adhesive or other approved seaming methods recommended by the manufacturer shall be used for horizontal seams on

slopes. Overlaps which occur on slopes shall be constructed with the up slope GCL shingled over the down slope GCL. Alternate seaming methods may be approved if recommended by the manufacturer.

3.2.5 Protection

Only those GCL panels which can be anchored and covered in the same day shall be unpackaged and installed. If exposed GCL cannot be permanently covered before the end of a working day, it shall be temporarily covered with plastic or other waterproof material to prevent hydration.

3.3 REPAIRS

Holes or tears in GCL shall be repaired by placing a patch of GCL extending a minimum of 12 inches beyond the edges of the hole or tear on all sides. If recommended by the manufacturer, granular bentonite or bentonite mastic shall be applied in the overlap area. Patches shall be secured with a construction adhesive or other approved methods as recommended by the manufacturer.

-- End Of Section --

SECTION 02373

GEOTEXTILE

09/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4354	(1999) Sampling of Geosynthetics for Testing
ASTM D 4355	(1999) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1999a) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1997) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999a) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(1988; R 1996) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(2000) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(2001) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturing Quality Control Manual Sampling and Testing ; G-RE

A minimum of 7 days prior to scheduled use, manufacturer's quality control manual.

SD-07 Certificates

Geotextile ; G-RE

A minimum of 7 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.5.1 Delivery

The Contracting Officer shall be notified a minimum of 24 hours prior to delivery and unloading of geotextile rolls. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.5.2 Storage

Rolls of geotextile shall be protected from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic in an area where water will not accumulate.

1.5.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

Geotextile shall be a nonwoven pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material shall not be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1 - MINIMUM PHYSICAL REQUIREMENTS FOR GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	LBS	200	ASTM D 4632
PUNCTURE	LBS	80	ASTM D 4833
TRAPEZOID TEAR	LBS	80	ASTM D 4533
APPARENT OPENING SIZE	U.S. SIEVE	70	ASTM D 4751
PERMITTIVITY	SEC ⁻¹	1.0	ASTM D 4491
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D 4355

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer shall be responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

PART 3 EXECUTION

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile.

3.2.2 Placement

The Contractor shall notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles.

3.3 SEAMS

3.3.1 Overlap Seams

Geotextile panels shall be continuously overlapped a minimum of 12 inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, the upper panel shall be lapped over the lower panel.

3.4 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 14 days after installation.

3.5 REPAIRS

Torn or damaged geotextile shall be repaired. Clogged areas of geotextile shall be removed. Repairs shall be performed by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 12 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile rolls which cannot be repaired shall be removed and replaced.

3.6 COVERING

Geotextile shall not be covered prior to inspection and approval by the Contracting Officer. Cover soil shall be placed in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 3 feet. No equipment shall be operated directly on top of the geotextile without approval of the Contracting Officer. Equipment with ground pressures less than 7 psi shall be used to place the first lift over the geotextile. A minimum of 18 inches of soil shall be maintained between full-scale construction equipment and the geotextile. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

-- End Of Section --

SECTION 02374

GEOSYNTHETIC DRAINAGE LAYER

12/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 413	(1982; R 1998) Rubber Property - Adhesion to Flexible Substrate
ASTM D 1505	(1998) Density of Plastics by the Density-Gradient Technique
ASTM D 4218	(1996) Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
ASTM D 4491	(1999) Water Permeability of Geotextiles by Permittivity
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4716	(1995) Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic using a Constant Head
ASTM D 4751	(1999) Apparent Opening Size of Geotextiles
ASTM D 5199	(1998) Nominal Thickness of Geotextiles and Geomembranes
ASTM D 5261	(1992; R 1996) Measuring Mass per Unit Area of Geotextiles
ASTM D 5596	(1994) Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sampling and Testing ; G-RE

Manufacturer's quality control manual.

SD-06 Test Reports

Geosynthetic Drainage Layer ; G-RE

Manufacturer's quality control test results. Test results not meeting the requirements in Table 1 will result in rejection of applicable rolls.

1.5 DELIVERY, STORAGE AND HANDLING

Geosynthetic drainage layer material shall not be damaged during shipping, storage, or handling. Any drainage layer material found to be damaged shall be repaired or replaced. Material shall be delivered only after the required submittals have been approved. Each roll shall be labelled with the Manufacturer's name, product identification, lot number, roll number, and roll dimensions. Rolls that have attached geotextiles shall be individually wrapped in plastic.

PART 2 PRODUCTS

2.1 GEOSYNTHETIC DRAINAGE LAYER

The polymer used to manufacture the geonet component of the geosynthetic drainage layer shall be polyethylene which is clean and free of any foreign contaminants. Regrind material which consists of edge trimmings and other scraps may be used to manufacture the geonet; however, post-consumer recycled materials shall not be used. The geosynthetic drainage layer shall conform to the property requirements listed in Table 1 and shall be free of defects.

2.2 GEOTEXTILE PROPERTIES

The geonet shall be covered on top side with a nonwoven geotextile. Geocomposite shall be created by heat bonding geotextile to the geonet. Geotextile attached to the geocomposite shall meet the requirements listed in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. The value for AOS represents the maximum average roll value.

TABLE 1 - GEOSYNTHETIC DRAINAGE LAYER PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE	MINIMUM TESTING FREQUENCY
GEONET			
Thickness, minimum average	ASTM D 5199	200 mil	15,000 lbs
Thickness, lowest individual	ASTM D 5199	-10 percent	15,000 lbs
Polymer Density, minimum	ASTM D 1505	0.940 g/cc	200,000 lbs
Carbon Black Content	ASTM D 4218	2-3 percent	15,000 lbs
Carbon Black Dispersion	ASTM D 5596	Note 1	45,000 lbs
GEOTEXTILE			
Mass/Unit Area, minimum	ASTM D 5261	6.0 oz/sq yds	20,000 sq yds
Grab Strength, minimum	ASTM D 4632	160 lbs	20,000 sq yds
Permittivity, minimum	ASTM D 4491	1.0/sec	100,000 sq yds
AOS(O95), maximum	ASTM D 4751	0.21 mm	100,000 sq yds
GEOCOMPOSITE			
Transmissivity, minimum, including attached geotextile Note 2	ASTM D 4716	0.0001 m ² /sec	100,000 sq yds
Geonet/Geotextile Adhesion Note 3	ASTM D 413	0.5 lbs/inch	100,000 sq yds

Note 1: Carbon black dispersion for 10 different views:
8 of 10 in Category 1 or 2; and
All 10 in Category 1, 2, or 3.

Note 2: Manufacturing quality control transmissivity tests shall be measured using water at 20 degrees C with a gradient of 0.1. A minimum seating period of 100 hours and a minimum applied normal stress of 1.4 psi shall be used. Testing configuration shall include the following layers: steel plate, soil, drainage layer, geomembrane, steel plate.

Note 3: Average of five equally spaced tests across the roll width.

2.3 SAMPLING AND TESTING

2.3.1 Manufacturing Quality Control Testing

Manufacturing quality control test methods and frequencies shall be in accordance with Table 1 unless otherwise approved.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Surface Preparation

Prior to placement of the geosynthetic drainage layer, the subgrade shall be cleaned of all materials which could damage the drainage layer.

3.1.2 Placement

The geosynthetic drainage layer shall not be damaged during placement. Faulty or damaged material shall be replaced or repaired as specified in paragraph REPAIRS. The drainage layer shall be unrolled in the direction of maximum slope, keeping the net flat against the subgrade to minimize wrinkles and folds. Adequate ballast (e.g. sandbags) shall be placed to prevent uplift by wind prior to covering.

3.1.3 Seams and Overlaps

3.1.3.1 Geonet Side Seams

Geonet side seams shall be overlapped a minimum of 4 inches. Side seam fastener spacing shall be a maximum of 5 feet. In anchor trenches, fastener spacing shall be a maximum of 1 foot.

3.1.3.2 Geonet End Seams

Geonet end seams shall be overlapped a minimum of 1 foot. End seam fastener spacing shall be a maximum of 6 inches. The overlaps shall be in the direction of flow. Geonet to geonet contact shall be required at geocomposite end seam connections.

3.1.3.3 Geonet Fasteners

Geonet rolls shall be tied together with plastic fasteners. The fasteners shall be a contrasting color from the geonet and attached geotextiles. Metallic fasteners will not be allowed.

3.1.3.4 Geotextile Seams

The geotextile component of the geocomposite shall be thermally bonded or sewn using a prayer seam. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 18 inches of overlap. Holes placed in geotextile to allow seaming of geonet rolls shall be covered by placing geotextile cap strips. Cap strips shall be a minimum of 2 feet in width and shall be thermally bonded to the geotextile component of the geocomposite using approved methods.

3.1.3.5 Geocomposite Edges

Cap strips shall be placed over any exposed edges of geocomposite. Cap strips shall be as described in paragraph: Geotextile Seams.

3.2 REPAIRS

3.2.1 Geonet Damage

Repairs shall be made by placing a patch of the geosynthetic drainage layer over the damaged area. The patch shall extend a minimum of 2 feet beyond the edge of the damage. Approved fasteners, spaced every 6 inches around the patch, shall be used to hold the patch in place. If more than 25 percent of the roll width is damaged, approval must be obtained to repair or replace the damaged roll.

3.2.2 Geotextile Damage

Damaged geotextile shall be repaired by placing a patch of geotextile over the damaged area with a minimum of 12 inches of overlap in all directions. The geotextile patch shall be thermally bonded in place using approved methods.

3.3 PROTECTION AND BACKFILLING

The geosynthetic drainage layer shall be covered with the specified materials within 14 days of acceptance. Cover soil shall be placed from the bottom of the slope upward and shall not be dropped directly onto the drainage layer from a height greater than 3 feet. The cover soil shall be pushed out over the geosynthetic drainage layer in an upward tumbling motion so that wrinkles in the drainage layer do not fold over. No equipment shall be operated on the top surface of the geosynthetic drainage layer without permission from the Contracting Officer. The initial loose soil lift thickness shall be 12 inches. Equipment with ground pressures no greater than 7 psi shall be used to place the first lift of soil. A minimum of 18 inches of soil shall be maintained between construction equipment with a ground pressure greater than 7 psi and the drainage layer. Equipment placing cover soil shall not stop or start abruptly, make sharp turns, or travel at speeds exceeding 5 mph.

-- End Of Section --

SECTION 02374

GEOSYNTHETIC DRAINAGE LAYER

12/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 413	(1982; R 1998) Rubber Property - Adhesion to Flexible Substrate
ASTM D 1505	(1998) Density of Plastics by the Density-Gradient Technique
ASTM D 4218	(1996) Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
ASTM D 4491	(1999) Water Permeability of Geotextiles by Permittivity
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4716	(1995) Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic using a Constant Head
ASTM D 4751	(1999) Apparent Opening Size of Geotextiles
ASTM D 5199	(1998) Nominal Thickness of Geotextiles and Geomembranes
ASTM D 5261	(1992; R 1996) Measuring Mass per Unit Area of Geotextiles
ASTM D 5596	(1994) Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sampling and Testing ; G-RE

Manufacturer's quality control manual.

SD-06 Test Reports

Geosynthetic Drainage Layer ; G-RE

Manufacturer's quality control test results. Test results not meeting the requirements in Table 1 will result in rejection of applicable rolls.

1.5 DELIVERY, STORAGE AND HANDLING

Geosynthetic drainage layer material shall not be damaged during shipping, storage, or handling. Any drainage layer material found to be damaged shall be repaired or replaced. Material shall be delivered only after the required submittals have been approved. Each roll shall be labelled with the Manufacturer's name, product identification, lot number, roll number, and roll dimensions. Rolls that have attached geotextiles shall be individually wrapped in plastic.

PART 2 PRODUCTS

2.1 GEOSYNTHETIC DRAINAGE LAYER

The polymer used to manufacture the geonet component of the geosynthetic drainage layer shall be polyethylene which is clean and free of any foreign contaminants. Regrind material which consists of edge trimmings and other scraps may be used to manufacture the geonet; however, post-consumer recycled materials shall not be used. The geosynthetic drainage layer shall conform to the property requirements listed in Table 1 and shall be free of defects.

2.2 GEOTEXTILE PROPERTIES

The geonet shall be covered on top side with a nonwoven geotextile. Geocomposite shall be created by heat bonding geotextile to the geonet. Geotextile attached to the geocomposite shall meet the requirements listed in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. The value for AOS represents the maximum average roll value.

TABLE 1 - GEOSYNTHETIC DRAINAGE LAYER PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE	MINIMUM TESTING FREQUENCY
GEONET			
Thickness, minimum average	ASTM D 5199	200 mil	15,000 lbs
Thickness, lowest individual	ASTM D 5199	-10 percent	15,000 lbs
Polymer Density, minimum	ASTM D 1505	0.940 g/cc	200,000 lbs
Carbon Black Content	ASTM D 4218	2-3 percent	15,000 lbs
Carbon Black Dispersion	ASTM D 5596	Note 1	45,000 lbs
GEOTEXTILE			
Mass/Unit Area, minimum	ASTM D 5261	6.0 oz/sq yds	20,000 sq yds
Grab Strength, minimum	ASTM D 4632	160 lbs	20,000 sq yds
Permittivity, minimum	ASTM D 4491	1.0/sec	100,000 sq yds
AOS(O95), maximum	ASTM D 4751	0.21 mm	100,000 sq yds
GEOCOMPOSITE			
Transmissivity, minimum, including attached geotextile Note 2	ASTM D 4716	0.0001 m ² /sec	100,000 sq yds
Geonet/Geotextile Adhesion Note 3	ASTM D 413	0.5 lbs/inch	100,000 sq yds

Note 1: Carbon black dispersion for 10 different views:
8 of 10 in Category 1 or 2; and
All 10 in Category 1, 2, or 3.

Note 2: Manufacturing quality control transmissivity tests shall be measured using water at 20 degrees C with a gradient of 0.1. A minimum seating period of 100 hours and a minimum applied normal stress of 1.4 psi shall be used. Testing configuration shall include the following layers: steel plate, soil, drainage layer, geomembrane, steel plate.

Note 3: Average of five equally spaced tests across the roll width.

2.3 SAMPLING AND TESTING

2.3.1 Manufacturing Quality Control Testing

Manufacturing quality control test methods and frequencies shall be in accordance with Table 1 unless otherwise approved.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Surface Preparation

Prior to placement of the geosynthetic drainage layer, the subgrade shall be cleaned of all materials which could damage the drainage layer.

3.1.2 Placement

The geosynthetic drainage layer shall not be damaged during placement. Faulty or damaged material shall be replaced or repaired as specified in paragraph REPAIRS. The drainage layer shall be unrolled in the direction of maximum slope, keeping the net flat against the subgrade to minimize wrinkles and folds. Adequate ballast (e.g. sandbags) shall be placed to prevent uplift by wind prior to covering.

3.1.3 Seams and Overlaps

3.1.3.1 Geonet Side Seams

Geonet side seams shall be overlapped a minimum of 4 inches. Side seam fastener spacing shall be a maximum of 5 feet. In anchor trenches, fastener spacing shall be a maximum of 1 foot.

3.1.3.2 Geonet End Seams

Geonet end seams shall be overlapped a minimum of 1 foot. End seam fastener spacing shall be a maximum of 6 inches. The overlaps shall be in the direction of flow. Geonet to geonet contact shall be required at geocomposite end seam connections.

3.1.3.3 Geonet Fasteners

Geonet rolls shall be tied together with plastic fasteners. The fasteners shall be a contrasting color from the geonet and attached geotextiles. Metallic fasteners will not be allowed.

3.1.3.4 Geotextile Seams

The geotextile component of the geocomposite shall be thermally bonded or sewn using a prayer seam. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 18 inches of verlap. Holes placed in geotextile to allow seaming of geonet rolls shall be covered by placing geotextile cap strips. Cap strips shall be a minimum of 2 feet in width and shall be thermally bonded to the geotextile component of the geocomposite using approved methods.

3.1.3.5 Geocomposite Edges

Cap strips shall be placed over any exposed edges of geocomposite. Cap strips shall be as described in paragraph: Geotextile Seams.

3.2 REPAIRS

3.2.1 Geonet Damage

Repairs shall be made by placing a patch of the geosynthetic drainage layer over the damaged area. The patch shall extend a minimum of 2 feet beyond the edge of the damage. Approved fasteners, spaced every 6 inches around the patch, shall be used to hold the patch in place. If more than 25 percent of the roll width is damaged, approval must be obtained to repair or replace the damaged roll.

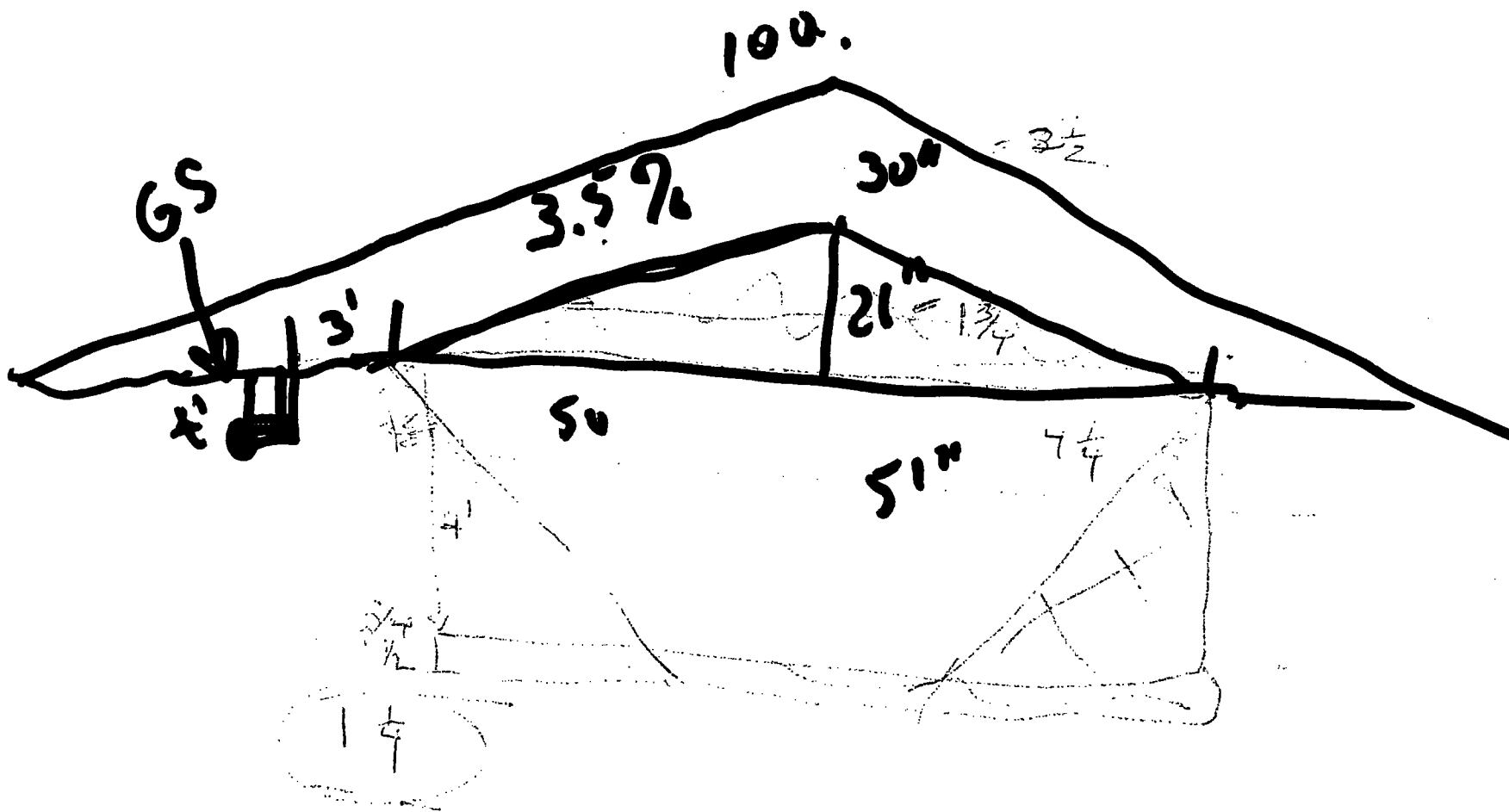
3.2.2 Geotextile Damage

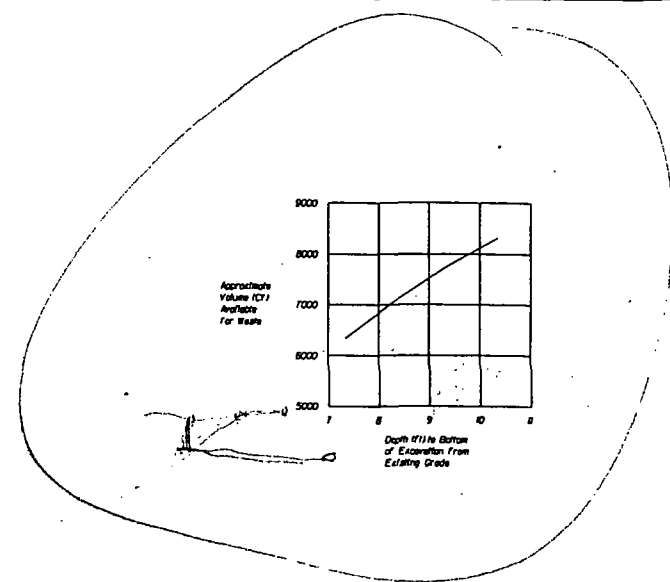
Damaged geotextile shall be repaired by placing a patch of geotextile over the damaged area with a minimum of 12 inches of overlap in all directions. The geotextile patch shall be thermally bonded in place using approved methods.

3.3 PROTECTION AND BACKFILLING

The geosynthetic drainage layer shall be covered with the specified materials within 14 days of acceptance. Cover soil shall be placed from the bottom of the slope upward and shall not be dropped directly onto the drainage layer from a height greater than 3 feet. The cover soil shall be pushed out over the geosynthetic drainage layer in an upward tumbling motion so that wrinkles in the drainage layer do not fold over. No equipment shall be operated on the top surface of the geosynthetic drainage layer without permission from the Contracting Officer. The initial loose soil lift thickness shall be 12 inches. Equipment with ground pressures no greater than 7 psi shall be used to place the first lift of soil. A minimum of 18 inches of soil shall be maintained between construction equipment with a ground pressure greater than 7 psi and the drainage layer. Equipment placing cover soil shall not stop or start abruptly, make sharp turns, or travel at speeds exceeding 5 mph.

-- End Of Section --





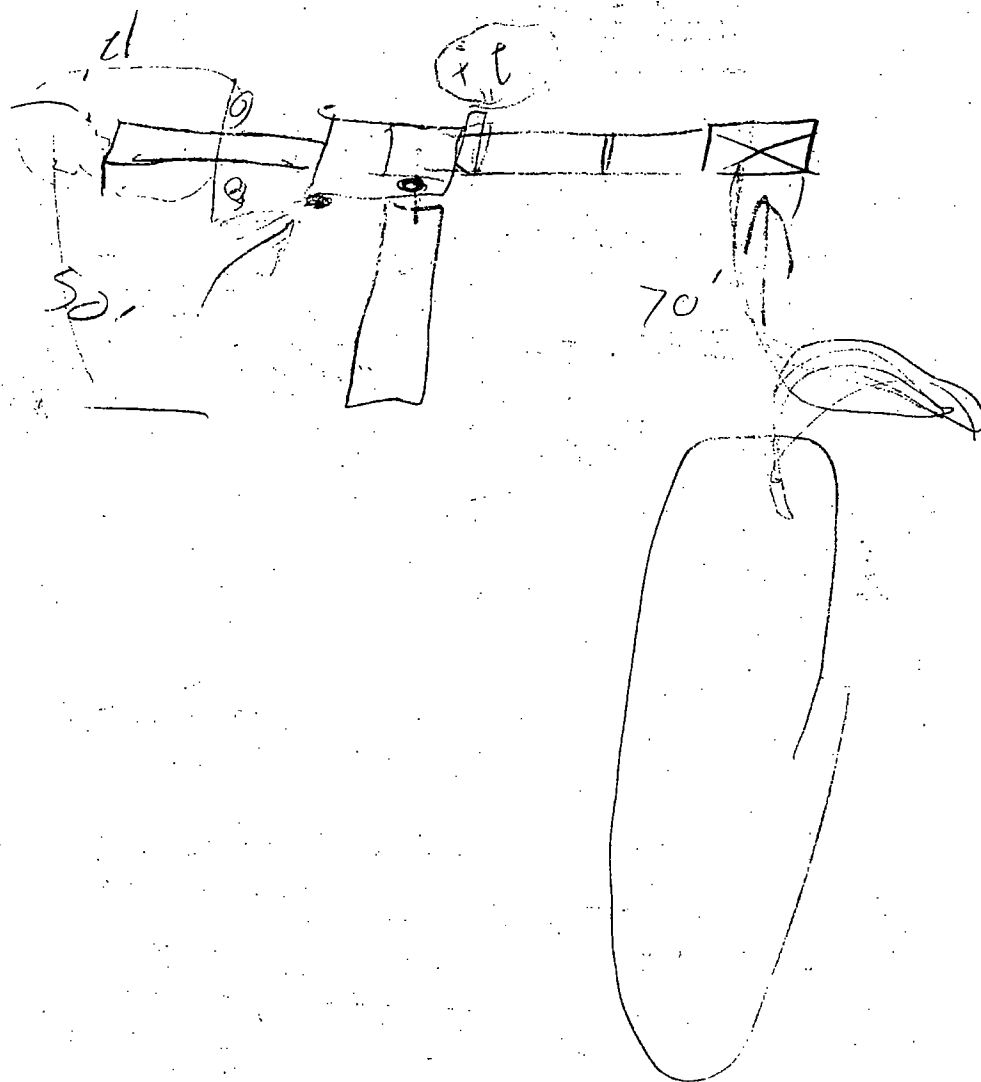
MTS

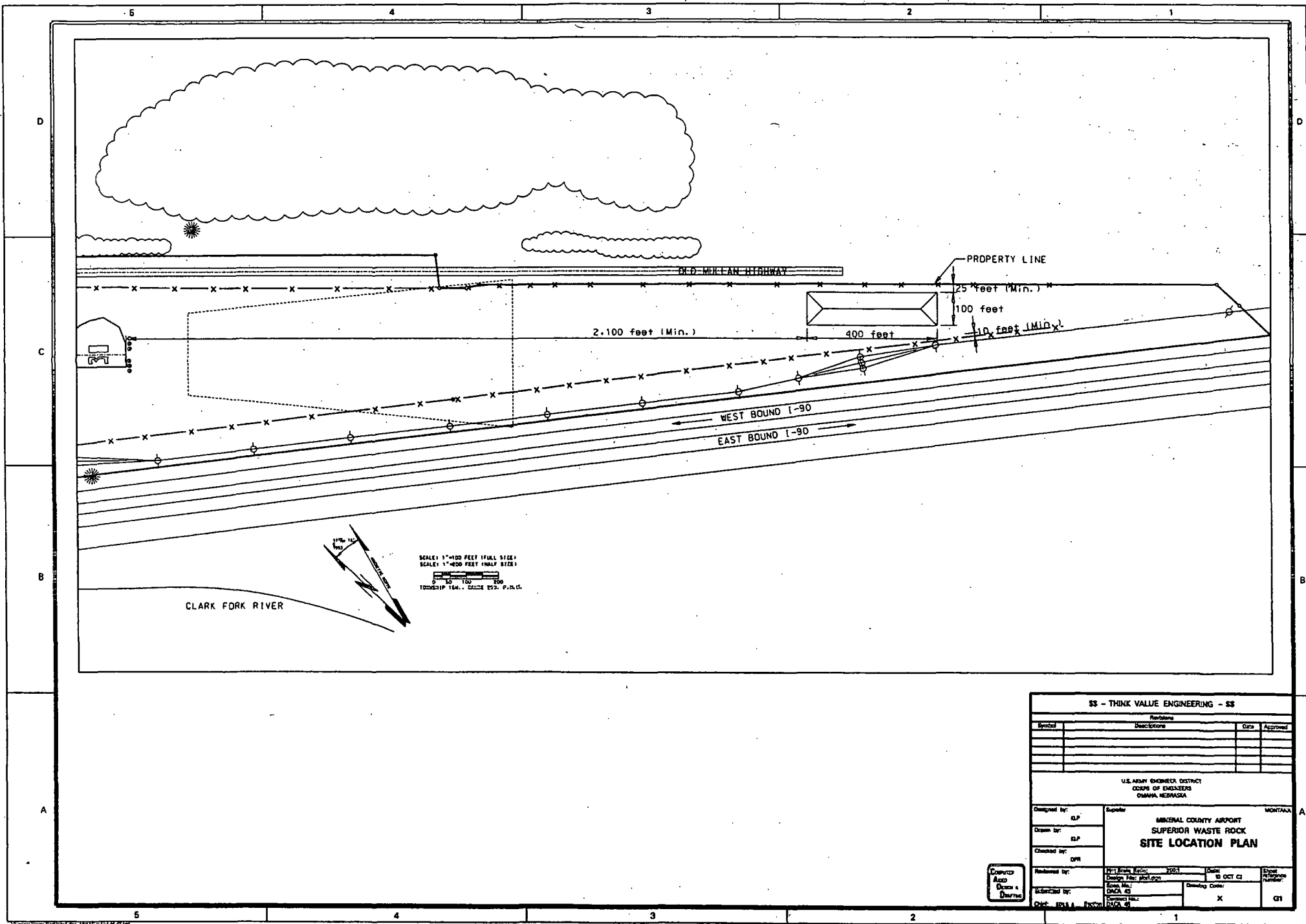


SCALE: 1 INCH = 2 FEET

2. All disturbed areas shall be seeded and mulched the same day. Seed shall consist of native grasses. Forage hay mulch shall be spread uniformly, in a continuous blanket, at a rate of 2 tons per acre, and crimped or rolled.

[illegible]





SS - THINK VALUE ENGINEERING - SS			
Symbol	Description	Date	Approved
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA			
Designed by:	SLP	Supervisor:	MONTANA
Drawn by:	SLP	MINERAL COUNTY AIRPORT SUPERIOR WASTE ROCK SITE LOCATION PLAN	
Checked by:	QPR	Reviewed by:	SLP
		Design File:	10 OCT 02
		Drawn Date:	X
		Checked Date:	01

SECTION 02140

SELECT FILL AND TOPSOIL FOR LANDFILL COVER

12/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2974	(1987) Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Materials
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials Handling Plan ; G-RE

The Materials Handling Plan describing placement and compaction procedures. At a minimum, the plan shall include documentation of equipment to be used (including ground pressures), traffic patterns, and sequence of operations. The plan shall also include a discussion of precautionary measures to prevent damage to underlying geosynthetics.

SD-06 Test Reports

Borrow Source Assessment ; G-RE
Select Fill Material Tests ; G-RE

Borrow Source Assessment Report at least 15 days prior to select fill and topsoil placement. No select fill shall be placed until the Borrow Source Assessment Report is approved. The report shall include the following: location of each borrow source; estimated

available quantity of borrow; logs of subsurface explorations; and laboratory test results.

1.4 EQUIPMENT

Equipment used to place the select fill and topsoil layers shall be as described in the approved Materials Handling Plan. Equipment shall not accelerate or brake suddenly, turn sharply, or be operated at speeds exceeding 5.0 miles per hour.

PART 2 PRODUCTS

2.1 SELECT FILL

Select fill shall comply with the criteria listed in Table 1 and shall be free of debris, frozen materials, angular rocks, roots, and organics.

2.2 TOPSOIL

The existing topsoil shall be stripped to a depth of 6 inches and stockpiled for use on the cover system.

TABLE 1 - REQUIRED PHYSICAL PROPERTIES OF SELECT FILL

Property	Test Value	Test Method
Soil classification	Lean clay (CL) Clayey sand (SC) Silty Gravel (GM) Clayey Gravel (GC) Silty Sand (SM) Clayey Sand (SC)	ASTM D 2487
Max. particle size (inches)	1.0	ASTM D 422

PART 3 EXECUTION

3.1 BORROW SOURCE ASSESSMENT

3.1.1 Select Fill

3.1.1.1 Classification Testing

Borrow source assessment tests shall be performed on each principal type or combination of materials proposed for use in the select fill layer to ensure compliance with specified requirements. At least one set of borrow assessment tests shall be performed on each borrow source proposed for use. A set of borrow source assessment tests shall consist of Atterberg limits (ASTM D 4318), particle size analysis (ASTM D 422), and moisture content (ASTM D 2216). Based on borrow source assessment testing, soils shall be classified in accordance with ASTM D 2487.

3.1.3 Chemical Contamination Testing

Borrow used for select fill shall be free of contamination. The Contractor shall be responsible to verify that all borrow is clean and free of chemical contamination.

3.2 INSTALLATION

3.2.1 Select Fill Placement

No equipment shall be operated on the top surface of geosynthetics without permission from the Contracting Officer. Select fill shall be pushed out over geosynthetics in an upward tumbling motion so that wrinkles in geosynthetics do not fold over. Soil shall not be dropped directly onto geosynthetics from a height greater than 3 feet. On slopes, select fill shall be placed from the bottom of the slope upward.

3.2.1.1 Initial Lift of Select Fill Placed Over Geosynthetics

The first lift of soil placed over geosynthetics shall be a minimum of 12 inches in loose thickness. Low ground pressure equipment with ground pressures less than 7 psi shall be used to place and traffic compact the first lift of select fill. Traffic compaction shall consist of a minimum of 2 passes over all areas.

3.2.1.2 Subsequent Lifts of Select Fill

The loose lift thickness of each subsequent lift shall be no greater than 12 inches. Low ground pressure equipment shall be used to place the second lift of select fill. Traffic compaction shall consist of a minimum of 2 passes over all areas. Full scale placement and compaction equipment shall be allowed on areas underlain by geosynthetics only after the second loose lift of soil has been placed. The top surface of the select fill layer shall be scarified prior to placement of the topsoil layer.

3.2.2 Topsoil Placement

Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading. Topsoil shall be placed in one lift and shall be evenly spread to a final compacted thickness of 6 inches. Topsoil shall be traffic compacted using approved placement equipment. On slopes, topsoil shall be placed from the bottom of the slope upward.

3.3 CONSTRUCTION TOLERANCES

Finished surfaces shall be uniformly graded and shall be free from depressions, mounds, or windrows. Grade stakes shall not be driven into the select fill layer to control placement.

3.4 CONSTRUCTION TESTS

3.4.1 Select Fill Material Tests

During construction of the select fill layer, representative samples shall be taken for testing at the frequencies listed in Table 2 from the borrow source. Test results must comply with the requirements listed in Part 2 Products or the material will be rejected for use.

TABLE 2 SELECT FILL MATERIAL TESTING FREQUENCIES

Property	Frequency	Test Method
Select Fill		
Grain size analysis	1,000 cubic yards	ASTM D 422
Atterberg limits	1,000 cubic yards	ASTM D 4318

3.5 PROTECTION

3.5.1 Damage

Erosion rills that exceed 1 inch in depth or other damage that occurs shall be repaired and grades re-established. Repairs to the select fill layer or topsoil layer shall be documented including location and volume of soil affected, corrective action taken, and results of retests.

3.5.2 Stockpiles

Storage or stockpiling of any material on the completed surface of the select fill layer or topsoil layer will not be permitted.

>-- End Of Section --

SECTION 02160

SOLIDIFICATION/STABILIZATION (S/S) OF CONTAMINATED MATERIAL

10/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 150 (1998) Portland Cement

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 268 Land Disposal Restrictions

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846 (Rev 0; updates I, II, IIA, IIB and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II)

1.3 SYSTEM DESCRIPTION

An pug mill S/S system shall be used which provides a safe, reliable method to treat contaminated material so that the treated material conforms to paragraph PERFORMANCE REQUIREMENTS. A system or procedure, other than described in this section, may be used if the approved SUBMITTALS demonstrate equivalent capabilities. Such approval does not relieve the Contractor of responsibility for meeting specified requirements for safety, reliability, and performance.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-03 Product Data

Work Plan ; G-RE
Equipment ; G-RE, Quality Control Tests ; G-RE

An S/S Work Plan within 10 days after notice to proceed. No S/S of contaminated material shall be performed until the work plan is approved. A period of 3 days shall be allowed in the schedule for Government review and approval of the work plan. The work plan shall address the technical requirements listed in this section and shall include, but is not limited to the following:

a. Contractor Experience: Information to demonstrate that the S/S Contractor meets the qualification requirements outlined in Paragraph QUALIFICATIONS.

b. Mix Design: The proposed mix design and method of mixing to be used in treating the contaminated material. The proposed source of water to be used for the S/S process shall also be identified.

c. Equipment: Specifications for the proposed homogenization and mixing equipment, batching equipment, and process control instrumentation. Process flow diagrams, mixing times, and processing rates shall be included. Anticipated pretreatment of the contaminated material shall be identified.

d. Emissions: Air emissions, dust, and noise from the system shall be identified and estimated. Control systems required to maintain compliance with local, state, and federal regulations shall be described as appropriate. Air emissions, dust, and noise testing protocol to be performed during the test run and full scale operations shall also be described.

e. Quality Control: A quality control plan which addresses control and documentation of batch proportions, mixing time, mixing speed, sample collection, sample curing, and post-treatment testing.

f. Demobilization: A post-treatment cleanup and sampling plan for the treatment area.

Batch Proportions ; G-RE

Daily batch proportion and mixing quality control data.

SD-06 Test Reports

Post Treatment Testing ; G-RE

Results of post-treatment tests performed.

SD-07 Certificates

Reagents ; G-RE

Reagent composition, certificates of analysis, and MSDS documentation. A confidentiality agreement may be requested if proprietary reagents are being used.

1.5 PERFORMANCE REQUIREMENTS

The Toxicity Characteristic Leaching Procedure as specified in EPA SW-846 shall be performed on representative samples of treated material. The extract shall meet the chemical post-treatment testing criteria listed in Table 1. The treated material shall also meet the physical testing criteria listed in Table 1. The tests listed in Table 1 shall be performed on samples that have been cured for 3 days.

Table 1. POST-TREATMENT TEST CRITERIA

TEST	TEST VALUE
Arsenic	5 mg/L
Cadmium	1 mg/L
Chromium (Total)	5 mg/L
Lead	5 mg/L

1.5.1 Disposal of Treated Material

The treated material, upon meeting the physical and chemical testing criteria, shall be placed within the stabilized waste pile.

1.5.2 Emission Controls

The S/S system shall include control apparatus necessary to meet local, state, and/or federal regulations for air emissions and dust.

1.5.3 Noise Control

The S/S system shall meet state and local noise pollution control regulations.

1.6 QUALIFICATIONS

1.6.1 Contractor Experience

The Contractor shall have successfully completed at least 5 S/S projects of comparable size and scope in accordance with local, state, and federal requirements using the proposed system or a similar system.

1.6.2 Key Personnel

Key personnel shall have a minimum of 3 years of S/S field experience. Key personnel shall include system operators, quality control personnel, and supervisory engineering and technical staff involved with the S/S system operation.

1.8 EQUIPMENT

1.8.1 Mixing Equipment

The mixing equipment shall have a minimum capacity adequate to meet performance and schedule requirements and shall be equipped with positive means for controlling the mix proportions, maintaining the time of mixing constant, and maintaining the appropriate speed of rotation of the mixer.

1.8.2 Reagent Feed Units

Satisfactory means, incorporating weighing, metering or volumetric measurement shall be provided to separately batch the required amount of each reagent. Silos and feeders shall be equipped and operated so that no

caking of material or variation in feed occurs. Provision shall be made so that each reagent can be easily sampled.

1.8.3 Accuracy of Measurement Equipment

Scales, meters, and volumetric measuring devices used for measuring contaminated material, reagents, and water for S/S processing shall be accurate to plus or minus 0.1 percent of the quantity being measured. A check of calibration of measuring equipment shall be performed once every 5 working days.

1.9 MIX DESIGN

The Contractor shall select a mix design which meets the performance criteria listed in Table 1 for use during full scale treatment. A preliminary treatability study has been performed on the contaminated materials. Results of this study are provided for information only. The mix design shall consist of a minimum of 7 percent Portland cement by weight. Portland cement shall meet the Type I or Type II requirements of ASTM C 150.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Water

Water shall not contain concentrations of oil, acid, salt, alkali, organic matter, or other deleterious substances which will be detrimental to the successful execution of the S/S treatment process. Potable water shall be used where available. The Government may require the Contractor to perform chemical analyses on representative water samples if the water appears to be of questionable quality.

2.1.2 Reagents

The chemical composition of reagents used shall be provided to the Government. A certificate of analysis supplied by the vendor shall accompany each shipping unit of reagent. Reagents shall be shipped in properly labeled containers with instructions for handling and storage. The instructions shall be strictly adhered to.

PART 3 EXECUTION

3.1 STOCKPILES

Stockpiles shall be maintained for storing contaminated material prior to treatment. Stockpile shall include:

a. A geomembrane cover with a minimum thickness of 10 mils to prevent precipitation from entering the stockpile.

b. Berms surrounding the stockpile that are a minimum of 12 inches in height.

3.2 OPERATION

3.2.1 Weather Conditions

S/S shall not take place in an ambient temperature below 40 degrees F without approval. Provisions shall be made to maintain the temperature of the treated material above freezing while curing. Contaminated material shall not be treated if it contains any frozen material. The temperature of the S/S material immediately after treatment shall not exceed 90 degrees F without approval. S/S shall not be performed during periods of heavy rainfall if this will result in the addition of excess water to the mixture.

3.2.2 Dissimilar Materials

Dissimilar materials that testing has indicated need different mix ratios, shall not be mixed together.

3.2.3 Oversize Material

Contaminated material that exceeds the maximum allowable particle size of the S/S mixing unit and that is amenable to treatment shall be reduced to a size that the mixing unit can accept. Oversize material that cannot be reduced to an allowable size for the S/S unit shall be treated in accordance with 40 CFR 268. After treatment, the material shall be disposed of in the proposed stabilized waste pile.. Hazardous residual produced in treating the oversize material shall be disposed of in accordance with applicable local, state and federal regulations.

3.3 FIELD DEMONSTRATION

Prior to full-scale operations, a start-up field demonstration shall be performed. At least 50 cubic yards of contaminated material shall be processed and the tests listed in Table 2 shall be performed on 3 representative samples of the treated material.

3.3.1 Full-Scale Processing Equipment

The full-scale processing equipment shall be used for the field demonstration. Reagents, mix ratios, and mixing procedures used during the field demonstration shall be the same as those used for the remainder of the work.

3.3.2 Sampling Locations

Contaminated material used for the field demonstration shall be obtained from representative material from the waste stockpiles.

3.3.3 Testing

Testing shall be performed to verify that the treated material from the field demonstration meets the specified physical and chemical criteria. If the treated material produced during the field demonstration does not pass the testing requirements, an equal quantity of the same type of material which failed shall be treated using a new mix design or procedure.

3.3.4 Volume Increase

The estimated increase in volume resulting from treatment shall be determined and reported with the field demonstration test results. Volume increase shall be determined by comparing the volume of in situ contaminated material to be treated to the volume of treated material using the following formula:

$B = 100 \times [(1+R) \times (D \text{ in situ}/D \text{ treated}) - 1]$, where

B = Volume increase in percent.

R = Dry weight ratio of solidifying agent to waste.

D in situ = Dry unit weight of in situ waste.

D treated = Dry unit weight of compacted treated material.

3.3.5 Field Demonstration Test Results

After completion of the field demonstration, contaminated material may continue to be processed. However, if test results from the field demonstration do not pass the criteria listed in Table 1, the contaminated material treated with the failing mix design shall be reprocessed with a working mix design.

3.4 QUALITY CONTROL PROCEDURES

3.4.1 Batch Proportions

Mixing time, mixing speed, and amounts of contaminated material, reagents, and water added to each batch shall be recorded. Mixing time, mixing speed, and batch proportions shall be maintained within the limits specified in the approved Work Plan and as modified during the field demonstration.

3.4.2 Segregation

Representative treated material shall be used for post-treatment testing. Table 2 lists the frequency at which post-treatment testing shall be performed. Treated material can be placed directly in the treated waste pile, and shall be placed such that the material from specific batches/runs can be defined and removed if it fails post-treatment testing.

3.4.3 Quality Control Tests

The tests listed in Table 2 shall be performed on representative samples of treated material. Samples for quality control and quality assurance testing shall be collected immediately after treatment and allowed to cure as specified in ASTM D 4832 or by another approved method. Samples shall meet the post-treatment testing criteria listed in Table 1.

Table 2. POST-TREATMENT QUALITY CONTROL TESTING FREQUENCY

Standard Test Procedure	Frequency/Cubic yards
TCLP EPA SW-846 1311/6010	1 per 100
Volume Increase ASTM D 1556	1 per 500

3.4.4 Retesting and Reprocessing

Retesting and reprocessing shall be performed for treated material that does not meet the physical and chemical requirements listed in Table 1.

3.4.4.1 Retesting

Any unit that fails post-treatment quality control or quality assurance testing shall be retested or reprocessed. If the Contractor elects to retest the unit, two additional samples shall be collected and tested for the failed parameter. If both tests pass, reprocessing of the unit will not be required. If either sample fails, the unit shall be reprocessed.

3.4.4.2 Reprocessing

If the Contractor reprocesses a unit of material, the unit shall be sampled and tested as described in paragraph Quality Control Tests after reprocessing.

3.4.5 Adjustments to Mix Design

Subject to approval, the mix design may be changed based on the characteristics of the material being treated.

3.4.6 Quality Assurance Testing

The Contracting Officer may require additional quality assurance tests as a result of failed quality assurance or quality control tests. The Contracting Officer may also require additional quality assurance tests due to changes in the mix design or physical appearance of the contaminated material.

-- End Of Section --